Mumbai University

Question Paper

[IDOL – Revised Course]

(May – 2017)

PAPER - II

DIGITAL

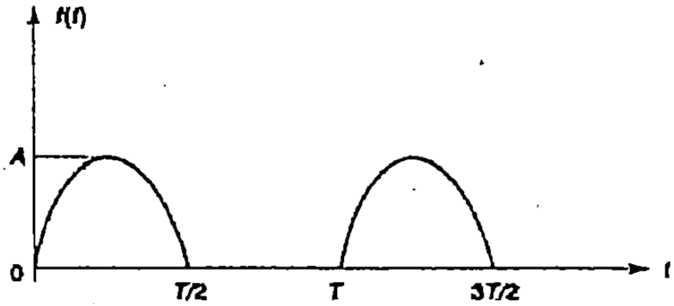
SIGNALS AND SYSTEMS

Time: 3 Hours **Total Marks:** 100

N.B.: **(1)** *All Question are Compulsory.*
(2) *Make Suitable Assumptions Wherever Necessary And State The Assumptions Made.*
(3) *Answer To The Same Question Must Be Written Together.*
(4) *Number To The Right Indicates Marks.*
(5) *Draw Neat Labeled Diagrams Wherever Necessary.*
(6) *Use of Non – Programmable Calculator is allowed.*

Q.1 ATTEMPT ANY TWO QUESTIONS: (10 MARKS)

(A) Obtain the trigonometric Fourier Series for the half wave rectified wave shown below: **(5)**



(B) Draw the pole-zero plot for $V(s) = \frac{(S+1)\,(S+3)}{(S+2)\,(S+4)}$. Evaluate $v(t)$ by using the pole-zero diagram. Confirm the result analytically. **(5)**

(C) For a low pass RC network, $R = 1\ M\Omega$ and $C = 1\ \mu F$. Determine the output response for n in the range $0 \leq n \leq 3$ when input has a step response of magnitude 2 V and the sampling frequency $f_s = 50\ Hz$ **(5)**

(D) What are the advantages and disadvantages of digital signal processing over Analog Signal Processing? **(5)**

Q.2 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) What is meant by Quantisation and Encoding? Explain. **(5)**

(B) Explain Periodic and Aperiodic Signals with examples. **(5)**

(C) State and prove Parseval's Theorem for Fourier Transform. **(5)**

(D) What are Energy and Power Signals? Determine if the following Signals are Energy Signals or Power Signals or neither: **(5)**
(i) $x(t) = tu(t)$
(ii) $x(n) = (-0.8)^n u(n)$

(E) Determine the Fourier Transform Signum Function and plot the Amplitude and Phase Spectra. **(5)**

(F) State any ten properties of unit impulse function $\delta(t)$. **(5)**

Q.3 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Define Laplace Transform and Inverse Laplace Transform. What is region of Convergence? **(5)**

(B) Find the Laplace Transform of $\sin^3 3t$. **(5)**

(C) Derive from the principles, the Laplace Transform of a Unit Step Function. Hence or otherwise determine the Laplace Transform of a Unit Ramp Function and a Unit Impulse Function. **(5)**

(D) If $\{f1(t)\} = F1(s)\ and\ L\{f2(t)\} = F2(s)$, show that $L\{f1(t).f2(t)\} = F1(s).F2(s)$ **(5)**

(E) Find the Laplace Transform of $Cosat.Cosbt$ **(5)**

(F) Obtain Laplace Transform for step and Impulse Responses of a Series R-L Circuit. **(5)**

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Q.4 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Determine the convolution of the two sequences $x(n) = \{2,1,1,0,5\}$ and $h(n) = \{2,3,2,1\}$ **(5)**

(B) State and explain any five properties of z-transform. **(5)**

(C) With reference to z-Transform, explain the initial and final value theorem. **(5)**

(D) State the Contour-Integration Residue method to calculate Inverse Z-Transformation. Hence obtain Inverse Z-Transform of $X(z) = \frac{1}{(z-1)\,(z+3)}$. **(5)**

(E) Convolute the sequences $x(n)$ and $h(n)$ where **(5)**

$x(n) = 0, n < 0 \qquad h(n) = 0, n < 0$

$\quad = a^n, n \geq 0 \qquad\quad = b^n, n \geq 0$

(F) Determine the inverse z-transform of **(5)**

$$X(z) = \frac{1}{(Z+2)^2};\ |z| < \frac{1}{2}$$

Q.5 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) Compute the response of the system $y(n) = 0.7y(n-1) - 0.12y(n-2) + x(n-2)$ to the input $x(n) = mu(n)$ **(5)**

(B) What is convolution in Liner Time Invariant System? What are the properties of convolution? **(5)**

(C) Check whether the following digital systems are BIBO Stable **(5)**

(i) $y(n) = ax^2(n)$

(ii) $y(n) = ax(n) + b$

(D) The output $y(n)$ for an Linear Time Invariant system to the input $x(n)$ is $y(n) = x(n) - 2x(n-1) + x(n-2)$. Compute the magnitude and phase of the frequency response of the system for $|\omega \geq \pi|$ **(5)**

(E) Find the convolution of the Two Signals $y(n) - \frac{1}{12}y(n-1) - \frac{1}{12}y(n-2) = x(n)$ **(5)**

(F) Determine the step response for the system. **(5)**

Q.6 ATTEMPT ANY THREE QUESTIONS: (15 MARKS)

(A) What are the methods used to perform Fast Convolution? Explain any one method giving all the steps involved to perform Fast Convolution. **(5)**

(B) Determine DFT of the sequence $x(n) = \begin{cases} \frac{1}{8} & 0 \leq n \leq 2 \\ 0 & otherwise \end{cases}$ **(5)**

(C) Compute 8-point DFT of the sequence $x(n) = \{1, 1, 1,\ 1, 1, 1, 1, 1\}$ by using DIF FFT Algorithm. **(5)**

(D) Find the Discrete Time Fourier Transform for the following Finite Duration Sequence of length L Also find the inverse DTFT to verify $x(n)$ for $L = 3$ and $A = 1V$: **(5)**

$x(n) = A$ for $0 \leq n \leq L-1$

$$= 0\ otherwise.$$

(E) Find the Circular Periodic Convolution using DFT and IDFT of the two sequences: **(5)**

$x(n) = \{1, 1, 2, 2\}$ and $h(n) = \{1, 2, 3, 4\}$

(F) Compute the Circular Periodic Convolution Graphically of the Two Sequences: **(5)**

$x(n) = \delta(n) + \delta(n-1) - \delta(n-2) - \delta(n-3)$ and $h(n) = \delta(n) - \delta(n-2) + \delta(n-4)$

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Q.7 **ATTEMPT ANY THREE QUESTIONS: (15 MARKS)**

(A) Determine the Unit Sample Response of the Ideal Low Pass Filter? Why is it not realizable? **(5)**

(B) Design a Finite Impulse Response Low Pass Filter with a cut-off frequency of 1kHz and sampling rate of 4kHz with eleven samples using Fourier series. **(5)**

(C) Describe the Inverse Chebyshev Filters. **(5)**

(D) Explain the procedure for designing an FIR filter Kaiser Window. **(5)**

(E) Design a digital Chebyshev filter to satisfy the constraints. **(5)**

$$0.707 \leq \left|H\left(e^{jw}\right)\right| \leq 1, \qquad 0 \leq \omega \leq 0.2\pi$$
$$\left|H\left(e^{jw}\right)\right| \leq 0.1, \qquad 0.5\pi \leq \omega \leq \pi$$

Using bilinear transform and assuming $T = 1s$.

(F) Design a bandpass filter to pass frequencies in the range 1-2 rad/sec using Hanning window $N = 5$. **(5)**
